This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

---

1. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-4}{3}, \frac{4}{5}, \text{ and } \frac{6}{5}$$

The solution is $75x^3 - 50x^2 - 128x + 96$, which is option A.

A. $a \in [70, 77], b \in [-53, -41], c \in [-130, -119], \text{ and } d \in [86, 98]$

* $75x^3 - 50x^2 - 128x + 96$, which is the correct option.

B. $a \in [70, 77], b \in [50, 55], c \in [-130, -119], \text{ and } d \in [-100, -88]$

$75x^3 + 50x^2 - 128x - 96$, which corresponds to multiplying out $(3x - 4)(5x + 4)(5x + 6)$.

C. $a \in [70, 77], b \in [-53, -41], c \in [-130, -119], \text{ and } d \in [-100, -88]$

$75x^3 - 50x^2 - 128x - 96$, which corresponds to multiplying everything correctly except the constant term.

D. $a \in [70, 77], b \in [-251, -249], c \in [271, 273], \text{ and } d \in [-100, -88]$

$75x^3 - 250x^2 + 272x - 96$, which corresponds to multiplying out $(3x - 4)(5x - 4)(5x - 6)$.

E. $a \in [70, 77], b \in [-131, -126], c \in [-33, -27], \text{ and } d \in [86, 98]$

$75x^3 - 130x^2 - 32x + 96$, which corresponds to multiplying out $(3x - 4)(5x + 4)(5x - 6)$.

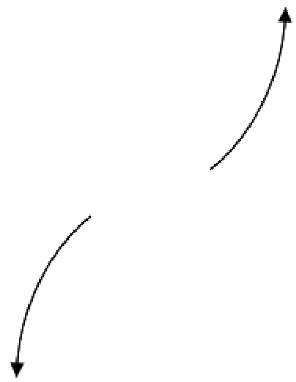
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(3x + 4)(5x - 4)(5x - 6)$

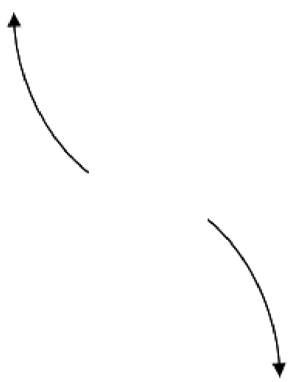
---

2. Describe the end behavior of the polynomial below.

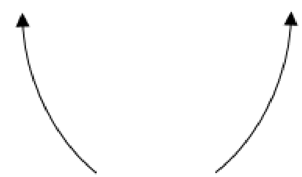
$$f(x) = 5(x - 7)^4(x + 7)^5(x - 4)^3(x + 4)^3$$

The solution is the graph below, which is option D.

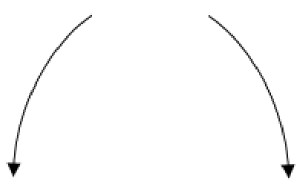




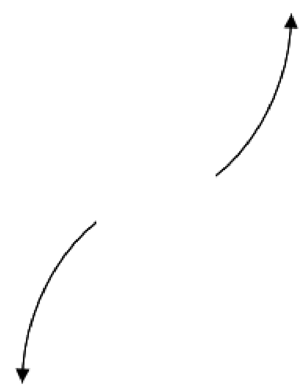
A.



C.



B.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

3. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-2 + 4i \text{ and } 1$$

The solution is $x^3 + 3x^2 + 16x - 20$, which is option D.

A. $b \in [0.7, 1.4], c \in [-6, -3], \text{ and } d \in [2, 11]$

$x^3 + x^2 - 5x + 4$, which corresponds to multiplying out $(x - 4)(x - 1)$.

B. $b \in [0.7, 1.4], c \in [-1, 5],$ and $d \in [-9, 0]$

$x^3 + x^2 + x - 2$, which corresponds to multiplying out $(x + 2)(x - 1)$.

C. $b \in [-6.9, -1.6], c \in [14, 23],$ and $d \in [13, 26]$

$x^3 - 3x^2 + 16x + 20$, which corresponds to multiplying out $(x - (-2 + 4i))(x - (-2 - 4i))(x + 1)$.

D. $b \in [1.6, 6.2], c \in [14, 23],$ and $d \in [-25, -14]$

* $x^3 + 3x^2 + 16x - 20$, which is the correct option.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

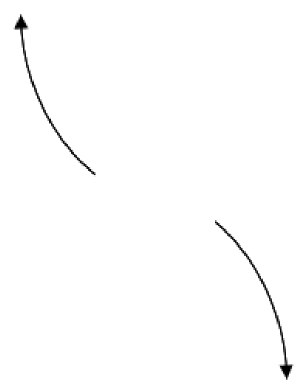
General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-2 + 4i))(x - (-2 - 4i))(x - (1))$.

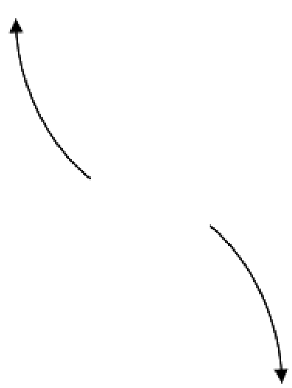
---

4. Describe the end behavior of the polynomial below.

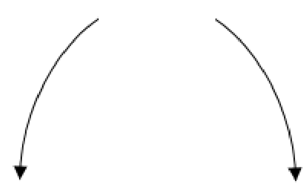
$$f(x) = -4(x - 4)^5(x + 4)^{10}(x + 6)^3(x - 6)^5$$

The solution is the graph below, which is option A.

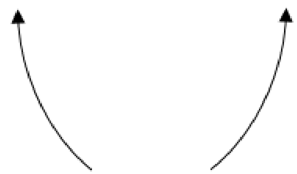


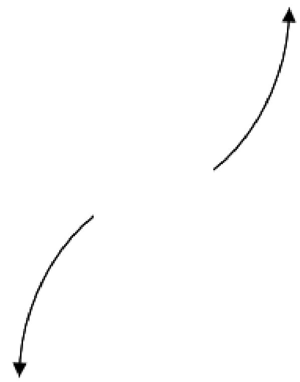


A.



B.

C. 

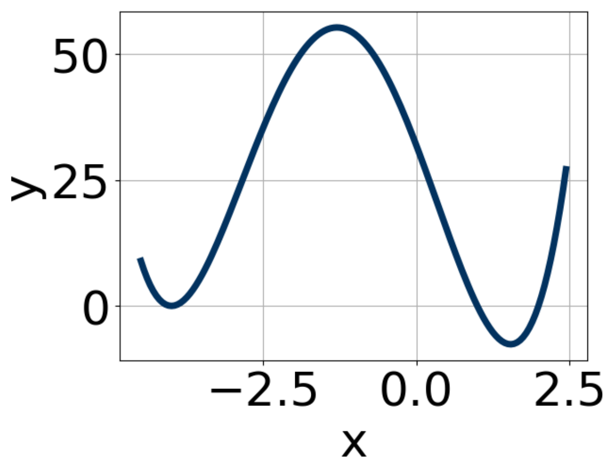
D. 

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

5. Which of the following equations *could* be of the graph presented below?



The solution is $10(x+4)^6(x-1)^{11}(x-2)^5$, which is option A.

A. $10(x+4)^6(x-1)^{11}(x-2)^5$

   * This is the correct option.

B. $10(x+4)^8(x-1)^{10}(x-2)^5$

   The factor $(x-1)$ should have an odd power.

C. $-12(x+4)^4(x-1)^5(x-2)^8$

   The factor $(x-2)$ should have an odd power and the leading coefficient should be the opposite sign.

D. $-6(x+4)^{10}(x-1)^{11}(x-2)^{11}$

   This corresponds to the leading coefficient being the opposite value than it should be.

E. $17(x+4)^7(x-1)^{10}(x-2)^5$

The factor -4 should have an even power and the factor 1 should have an odd power.

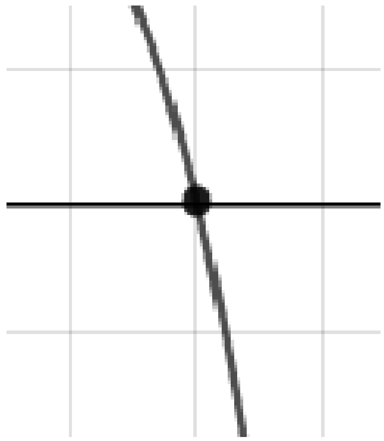
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

---

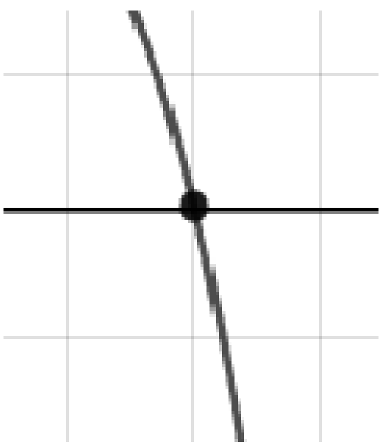
6. Describe the zero behavior of the zero $x = -5$ of the polynomial below.

$$f(x) = -9(x-5)^2(x+5)^7(x+7)^8(x-7)^{10}$$

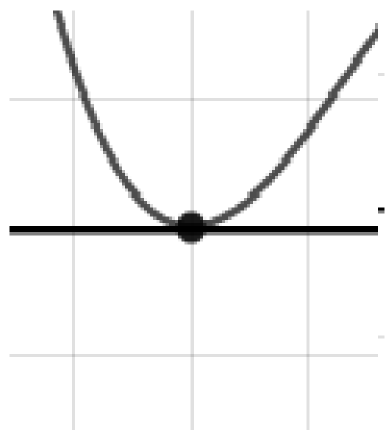
The solution is the graph below, which is option A.



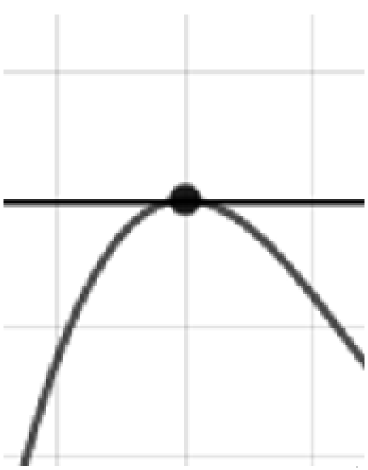
A.



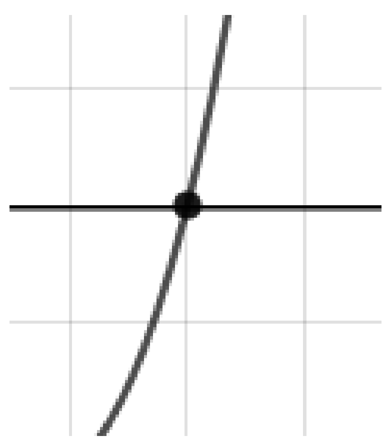
C.



B.



D.



E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

---

7. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-2 - 3i \text{ and } 2$$

The solution is $x^3 + 2x^2 + 5x - 26$, which is option B.

A. $b \in [-2.71, -1.5], c \in [3.3, 9.2]$, and $d \in [22.8, 26.7]$

$x^3 - 2x^2 + 5x + 26$, which corresponds to multiplying out $(x - (-2 - 3i))(x - (-2 + 3i))(x + 2)$.

B. $b \in [1.42, 2.12], c \in [3.3, 9.2]$, and $d \in [-26.6, -24.8]$

* $x^3 + 2x^2 + 5x - 26$, which is the correct option.

C. $b \in [0.14, 1.15], c \in [0.2, 1.1]$, and $d \in [-7.3, -4.4]$

$x^3 + x^2 + x - 6$, which corresponds to multiplying out $(x + 3)(x - 2)$.

D. $b \in [0.14, 1.15], c \in [-3.6, 0.6]$, and $d \in [-4.4, -1.3]$

$x^3 + x^2 - 4$, which corresponds to multiplying out $(x + 2)(x - 2)$.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-2 - 3i))(x - (-2 + 3i))(x - (2))$.

---

8. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-1}{4}, 7, \text{ and } \frac{7}{5}$$

The solution is $20x^3 - 163x^2 + 154x + 49$, which is option A.

A. $a \in [18, 22], b \in [-170, -159], c \in [152, 163]$, and $d \in [42, 51]$

* $20x^3 - 163x^2 + 154x + 49$, which is the correct option.

B. $a \in [18, 22], b \in [106, 113], c \in [-227, -221]$, and $d \in [42, 51]$

$20x^3 + 107x^2 - 224x + 49$, which corresponds to multiplying out $(4x - 1)(x + 7)(5x - 7)$.

C. $a \in [18, 22], b \in [-178, -171], c \in [231, 239]$, and $d \in [-53, -47]$

$20x^3 - 173x^2 + 238x - 49$, which corresponds to multiplying out $(4x - 1)(x - 7)(5x - 7)$.

D. $a \in [18, 22], b \in [159, 164], c \in [152, 163]$, and $d \in [-53, -47]$

$20x^3 + 163x^2 + 154x - 49$, which corresponds to multiplying out $(4x - 1)(x + 7)(5x + 7)$.

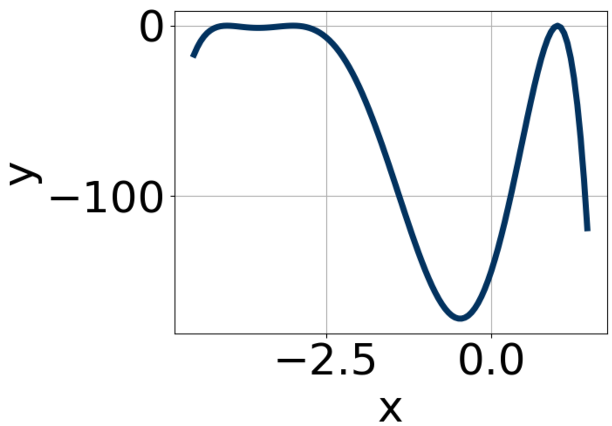
E. $a \in [18, 22], b \in [-170, -159], c \in [152, 163]$, and $d \in [-53, -47]$

$20x^3 - 163x^2 + 154x - 49$, which corresponds to multiplying everything correctly except the constant term.

General Comment: To construct the lowest-degree polynomial, you want to multiply out $(4x+1)(x-7)(5x-7)$

---

9. Which of the following equations *could* be of the graph presented below?



The solution is $-3(x+4)^6(x+3)^6(x-1)^8$, which is option D.

A. $-20(x+4)^{10}(x+3)^5(x-1)^7$

The factors $(x+3)$ and $(x-1)$ should both have even powers.

B. $9(x+4)^8(x+3)^8(x-1)^9$

The factor $(x-1)$ should have an even power and the leading coefficient should be the opposite sign.

C. $10(x+4)^4(x+3)^{10}(x-1)^6$

This corresponds to the leading coefficient being the opposite value than it should be.

D. $-3(x+4)^6(x+3)^6(x-1)^8$

* This is the correct option.

E. $-16(x+4)^6(x+3)^4(x-1)^5$

The factor $(x-1)$ should have an even power.

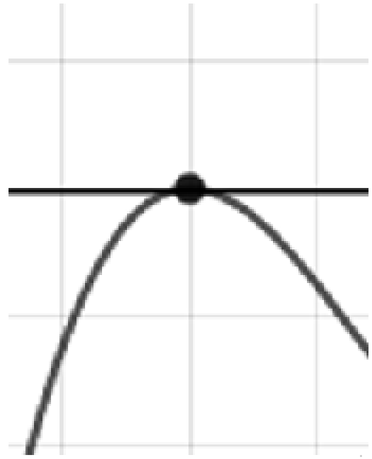
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

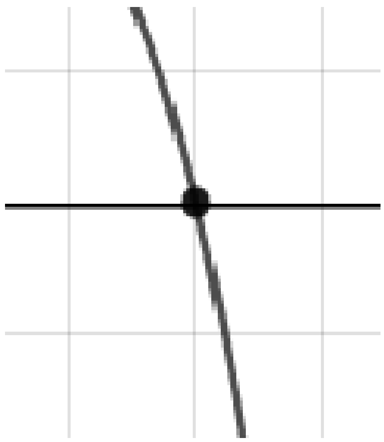
---

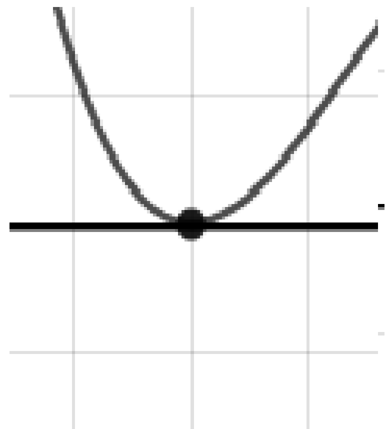
10. Describe the zero behavior of the zero $x = 7$ of the polynomial below.

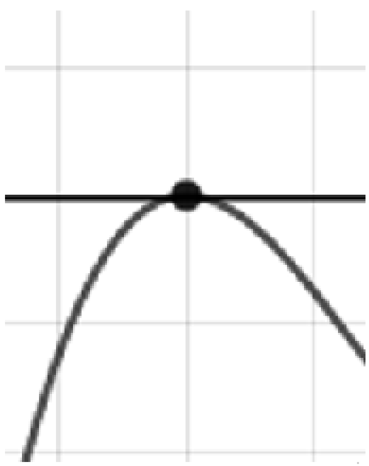
$$f(x) = -7(x+7)^5(x-7)^{10}(x-4)^4(x+4)^7$$

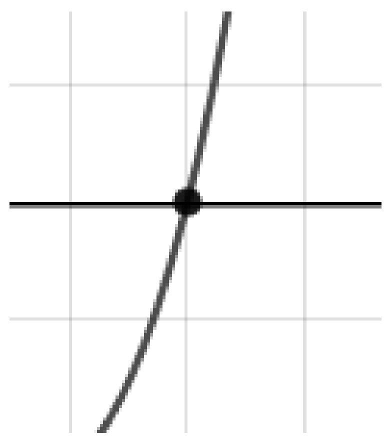
The solution is the graph below, which is option B.



A. 

C. 

B. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

---

11. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-7}{4}, -1, \text{ and } -3$$

The solution is $4x^3 + 23x^2 + 40x + 21$, which is option B.

A. $a \in [2, 5], b \in [21, 29], c \in [37, 41]$, and $d \in [-23, -18]$

$4x^3 + 23x^2 + 40x - 21$, which corresponds to multiplying everything correctly except the constant term.

B. $a \in [2, 5], b \in [21, 29], c \in [37, 41]$, and $d \in [20, 22]$

* $4x^3 + 23x^2 + 40x + 21$, which is the correct option.

C. $a \in [2, 5], b \in [-24, -16], c \in [37, 41]$, and $d \in [-23, -18]$

$4x^3 - 23x^2 + 40x - 21$, which corresponds to multiplying out $(4x - 7)(x - 1)(x - 3)$.

D. $a \in [2, 5], b \in [6, 12], c \in [-19, -11]$, and $d \in [-23, -18]$

$4x^3 + 9x^2 - 16x - 21$, which corresponds to multiplying out $(4x - 7)(x + 1)(x + 3)$.

E. $a \in [2, 5], b \in [0, 3], c \in [-33, -25]$, and $d \in [20, 22]$

$4x^3 + x^2 - 26x + 21$, which corresponds to multiplying out $(4x - 7)(x - 1)(x + 3)$.

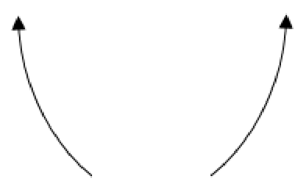
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(4x + 7)(x + 1)(x + 3)$

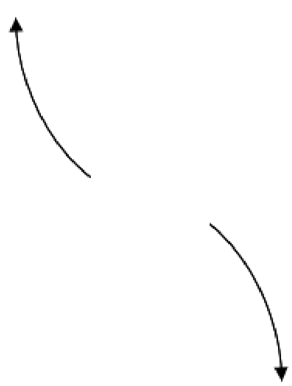
---

12. Describe the end behavior of the polynomial below.

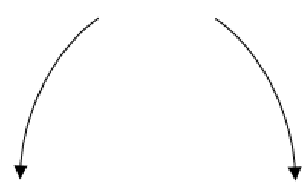
$$f(x) = 5(x + 4)^2(x - 4)^3(x + 8)^5(x - 8)^6$$

The solution is the graph below, which is option C.

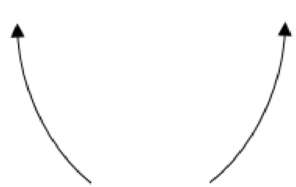




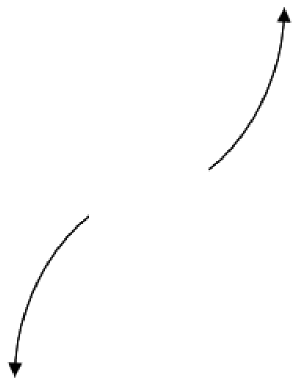
A.



B.



C.

D. 

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

13. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$4 - 5i \text{ and } 4$$

The solution is $x^3 - 12x^2 + 73x - 164$, which is option A.

A. $b \in [-13, -11], c \in [71, 74]$, and $d \in [-171, -156]$

* $x^3 - 12x^2 + 73x - 164$, which is the correct option.

B. $b \in [9, 15], c \in [71, 74]$, and $d \in [156, 167]$

$x^3 + 12x^2 + 73x + 164$, which corresponds to multiplying out $(x - (4 - 5i))(x - (4 + 5i))(x + 4)$.

C. $b \in [-6, 2], c \in [-11, -2]$, and $d \in [16, 20]$

$x^3 + x^2 - 8x + 16$, which corresponds to multiplying out $(x - 4)(x - 4)$.

D. $b \in [-6, 2], c \in [-1, 11]$, and $d \in [-28, -19]$

$x^3 + x^2 + x - 20$, which corresponds to multiplying out $(x + 5)(x - 4)$.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

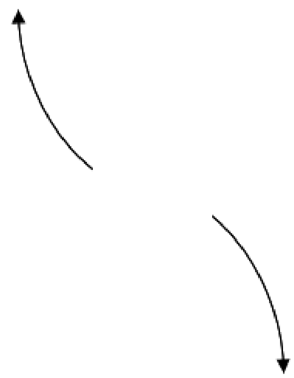
General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (4 - 5i))(x - (4 + 5i))(x - (4))$.

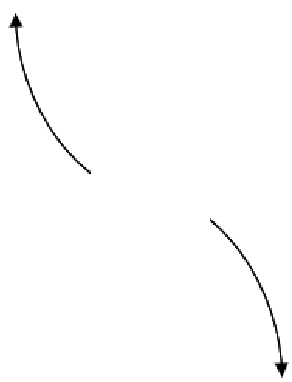
---

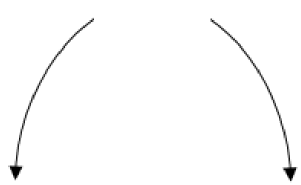
14. Describe the end behavior of the polynomial below.

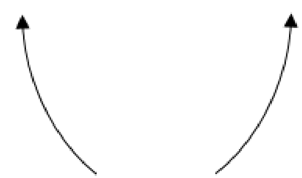
$$f(x) = -2(x + 7)^3(x - 7)^4(x - 8)^3(x + 8)^5$$

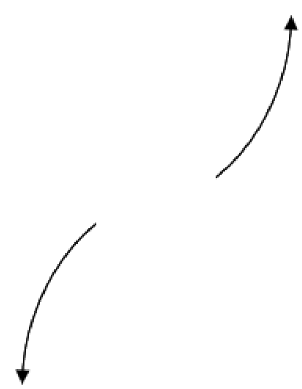
The solution is the graph below, which is option A.



A. 

B. 

C. 

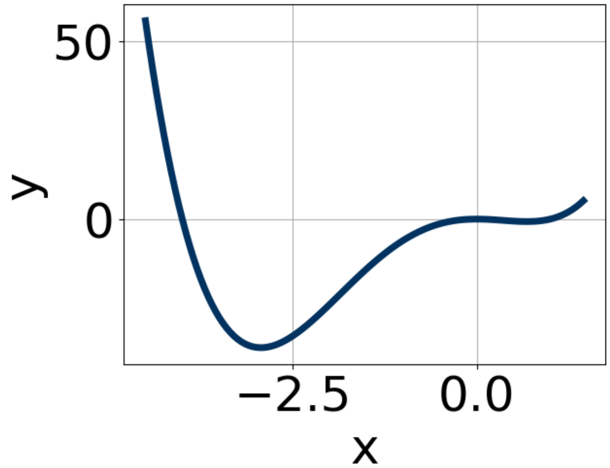
D. 

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

15. Which of the following equations *could* be of the graph presented below?



The solution is $16x^{10}(x-1)^5(x+4)^9$, which is option B.

A. $-7x^{10}(x-1)^9(x+4)^8$

The factor $(x+4)$ should have an odd power and the leading coefficient should be the opposite sign.

B. $16x^{10}(x-1)^5(x+4)^9$

* This is the correct option.

C. $-12x^8(x-1)^9(x+4)^9$

This corresponds to the leading coefficient being the opposite value than it should be.

D. $13x^{10}(x-1)^8(x+4)^{11}$

The factor $(x-1)$ should have an odd power.

E. $4x^5(x-1)^6(x+4)^9$

The factor 0 should have an even power and the factor 1 should have an odd power.

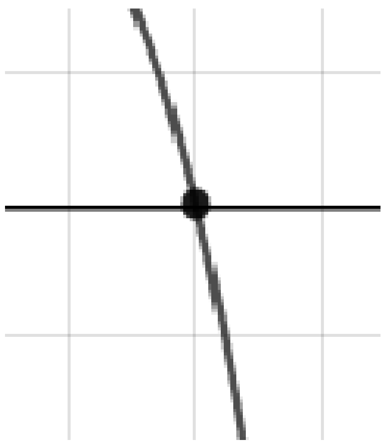
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

---

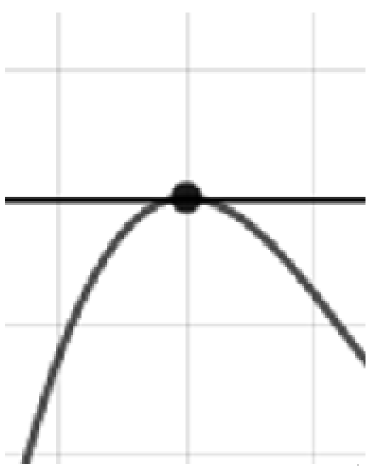
16. Describe the zero behavior of the zero $x = -7$ of the polynomial below.

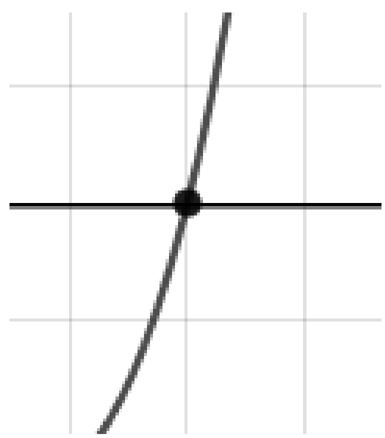
$$f(x) = -5(x-2)^6(x+2)^4(x+7)^6(x-7)^5$$

The solution is the graph below, which is option C.

A. 

C. 

B. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

---

17. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-3 + 2i \text{ and } -4$$

The solution is $x^3 + 10x^2 + 37x + 52$, which is option A.

A. $b \in [10, 19], c \in [32, 39]$, and $d \in [51, 63]$

* $x^3 + 10x^2 + 37x + 52$, which is the correct option.

B. $b \in [-1, 3], c \in [4, 8]$, and $d \in [11, 17]$

$x^3 + x^2 + 7x + 12$, which corresponds to multiplying out $(x + 3)(x + 4)$.

C. $b \in [-1, 3], c \in [-4, 3]$, and $d \in [-12, -5]$

$x^3 + x^2 + 2x - 8$, which corresponds to multiplying out $(x - 2)(x + 4)$.

D. $b \in [-11, -7], c \in [32, 39]$, and $d \in [-52, -50]$

$x^3 - 10x^2 + 37x - 52$, which corresponds to multiplying out $(x - (-3 + 2i))(x - (-3 - 2i))(x - 4)$.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-3 + 2i))(x - (-3 - 2i))(x - (-4))$.

---

18. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{7}{5}, \frac{-5}{2}, \text{ and } \frac{1}{2}$$

The solution is $20x^3 + 12x^2 - 81x + 35$, which is option B.

A. $a \in [18, 21], b \in [65, 73], c \in [23, 32]$, and $d \in [-35, -33]$

$20x^3 + 68x^2 + 31x - 35$, which corresponds to multiplying out $(5x + 7)(2x + 5)(2x - 1)$.

B. $a \in [18, 21], b \in [8, 17], c \in [-95, -77]$, and $d \in [33, 37]$

* $20x^3 + 12x^2 - 81x + 35$, which is the correct option.

C. $a \in [18, 21], b \in [8, 17], c \in [-95, -77]$, and $d \in [-35, -33]$

$20x^3 + 12x^2 - 81x - 35$, which corresponds to multiplying everything correctly except the constant term.

D. $a \in [18, 21], b \in [-33, -27], c \in [-68, -57]$, and $d \in [33, 37]$

$20x^3 - 32x^2 - 59x + 35$, which corresponds to multiplying out $(5x + 7)(2x - 5)(2x - 1)$.

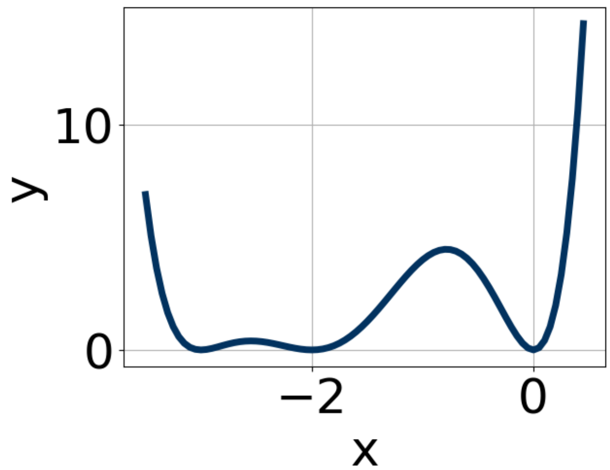
E. $a \in [18, 21], b \in [-18, -3], c \in [-95, -77]$, and $d \in [-35, -33]$

$20x^3 - 12x^2 - 81x - 35$, which corresponds to multiplying out $(5x + 7)(2x - 5)(2x + 1)$.

General Comment: To construct the lowest-degree polynomial, you want to multiply out $(5x - 7)(2x + 5)(2x - 1)$

---

19. Which of the following equations *could* be of the graph presented below?



The solution is $8x^6(x+3)^{10}(x+2)^{10}$, which is option D.

A. $14x^{11}(x+3)^6(x+2)^7$

The factors x and $(x+2)$ should both have even powers.

B. $16x^{10}(x+3)^4(x+2)^{11}$

The factor $(x+2)$ should have an even power.

C. $-4x^8(x+3)^8(x+2)^4$

This corresponds to the leading coefficient being the opposite value than it should be.

D. $8x^6(x+3)^{10}(x+2)^{10}$

* This is the correct option.

E. $-5x^8(x+3)^6(x+2)^7$

The factor $(x+2)$ should have an even power and the leading coefficient should be the opposite sign.

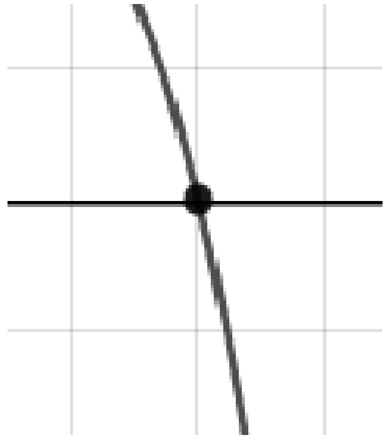
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

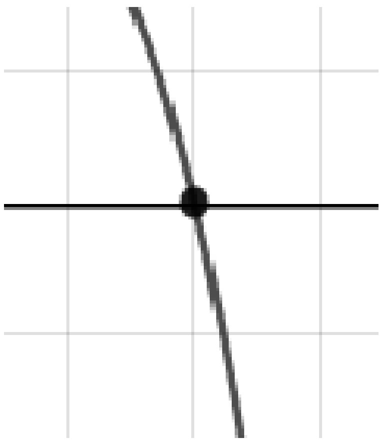
---

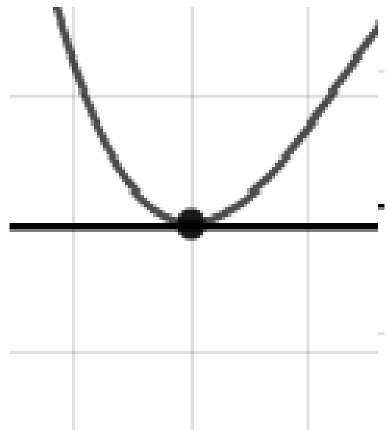
20. Describe the zero behavior of the zero $x = 9$ of the polynomial below.

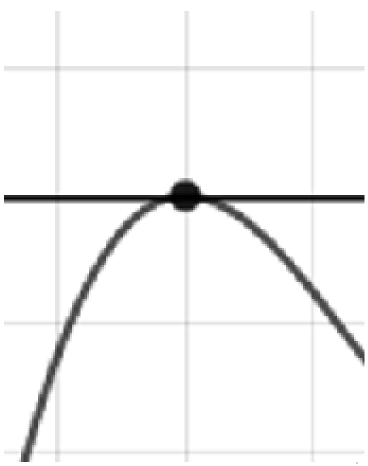
$$f(x) = -3(x+9)^6(x-9)^{11}(x-5)^8(x+5)^9$$

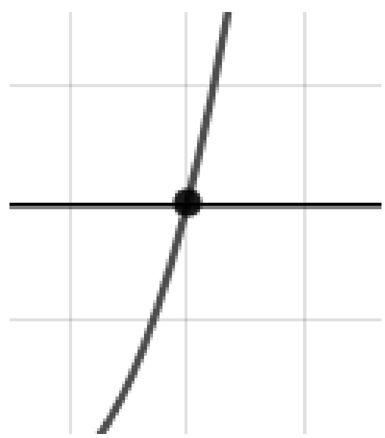
The solution is the graph below, which is option A.



A. 

C. 

B. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

---

21. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-5}{2}, \frac{4}{3}, \text{ and } -1$$

The solution is $6x^3 + 13x^2 - 13x - 20$, which is option D.

A. $a \in [1, 10], b \in [13, 15], c \in [-15, -4],$ and $d \in [10, 26]$

$6x^3 + 13x^2 - 13x + 20$, which corresponds to multiplying everything correctly except the constant term.

B. $a \in [1, 10], b \in [-2, 5], c \in [-31, -24],$ and $d \in [-22, -12]$

$6x^3 - 1x^2 - 27x - 20$, which corresponds to multiplying out $(2x - 5)(3x + 4)(x + 1)$.

C. $a \in [1, 10], b \in [-14, -11], c \in [-15, -4],$ and $d \in [10, 26]$

$6x^3 - 13x^2 - 13x + 20$, which corresponds to multiplying out $(2x - 5)(3x + 4)(x - 1)$.

D. $a \in [1, 10], b \in [13, 15], c \in [-15, -4],$ and $d \in [-22, -12]$

* $6x^3 + 13x^2 - 13x - 20$, which is the correct option.

E. $a \in [1, 10], b \in [-19, -15], c \in [-3, -2],$ and $d \in [10, 26]$

$6x^3 - 17x^2 - 3x + 20$, which corresponds to multiplying out $(2x - 5)(3x - 4)(x + 1)$.

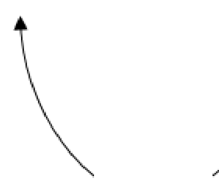
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(2x + 5)(3x - 4)(x + 1)$

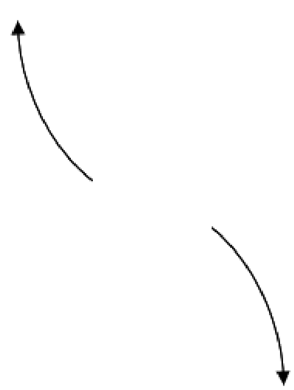
---

22. Describe the end behavior of the polynomial below.

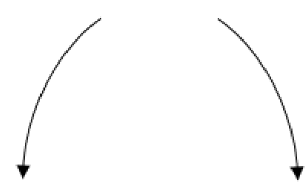
$$f(x) = 2(x - 3)^5(x + 3)^{10}(x + 7)^4(x - 7)^5$$

The solution is the graph below, which is option C.

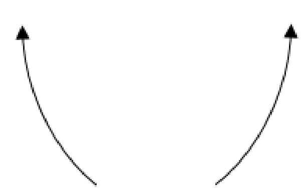




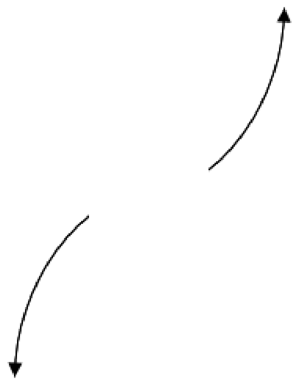
A.



B.



C.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

23. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-3 - 5i \text{ and } -4$$

The solution is $x^3 + 10x^2 + 58x + 136$, which is option C.

A. $b \in [-11, -8], c \in [57.4, 58.57], \text{ and } d \in [-141, -128]$

$x^3 - 10x^2 + 58x - 136$, which corresponds to multiplying out $(x-(-3-5i))(x-(-3+5i))(x-4)$.

B. $b \in [1, 5], c \in [8.96, 9.07], \text{ and } d \in [16, 25]$

$x^3 + x^2 + 9x + 20$, which corresponds to multiplying out $(x+5)(x+4)$.

C. $b \in [9, 15], c \in [57.4, 58.57], \text{ and } d \in [136, 145]$

* $x^3 + 10x^2 + 58x + 136$, which is the correct option.

D. $b \in [1, 5], c \in [6.8, 8.11], \text{ and } d \in [12, 18]$

$x^3 + x^2 + 7x + 12$, which corresponds to multiplying out $(x+3)(x+4)$.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

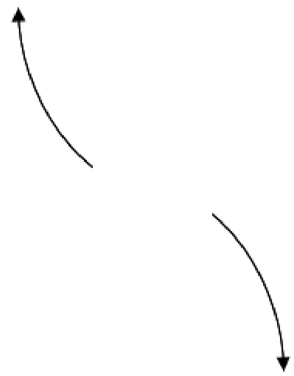
General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x-(-3-5i))(x-(-3+5i))(x-(-4))$.

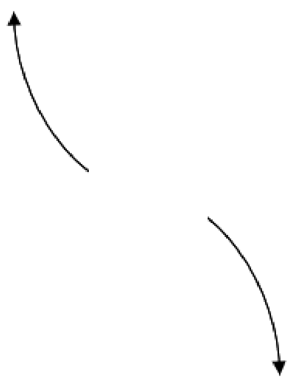
---

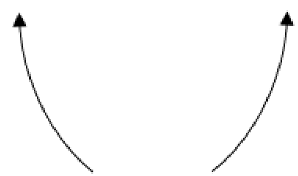
24. Describe the end behavior of the polynomial below.

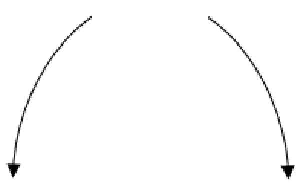
$$f(x) = -2(x-8)^4(x+8)^5(x+4)^2(x-4)^2$$

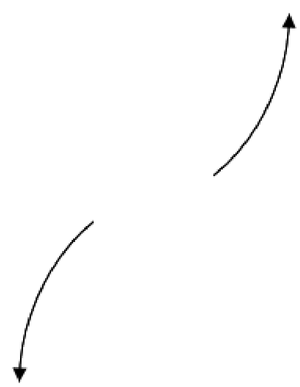
The solution is the graph below, which is option A.



A. 

C. 

B. 

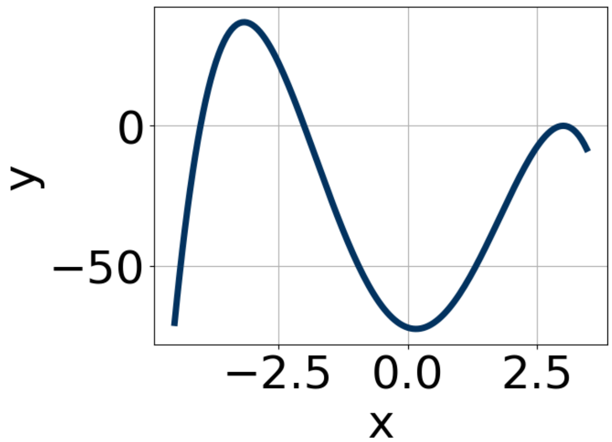
D. 

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

25. Which of the following equations *could* be of the graph presented below?



The solution is $-14(x-3)^8(x+4)^{11}(x+2)^5$, which is option E.

A. $-2(x-3)^6(x+4)^{10}(x+2)^5$

The factor $(x+4)$ should have an odd power.

B. $6(x-3)^{10}(x+4)^{11}(x+2)^7$

This corresponds to the leading coefficient being the opposite value than it should be.

C. $19(x-3)^6(x+4)^9(x+2)^{10}$

The factor $(x+2)$ should have an odd power and the leading coefficient should be the opposite sign.

D. $-19(x-3)^9(x+4)^6(x+2)^{11}$

The factor 3 should have an even power and the factor -4 should have an odd power.

E. $-14(x-3)^8(x+4)^{11}(x+2)^5$

* This is the correct option.

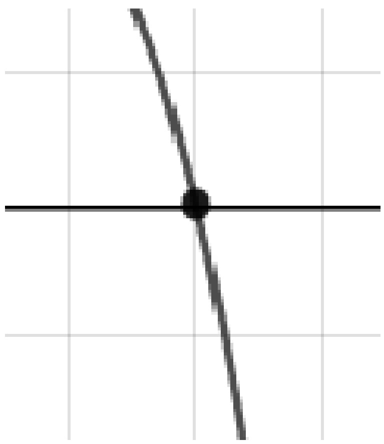
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

---

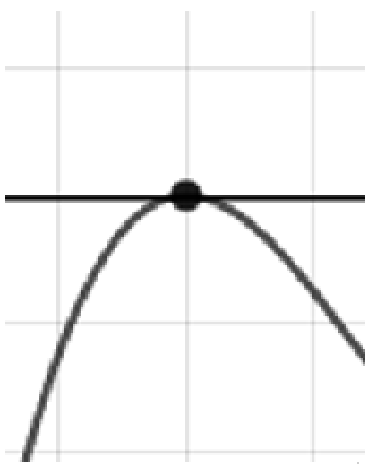
26. Describe the zero behavior of the zero $x = 9$ of the polynomial below.

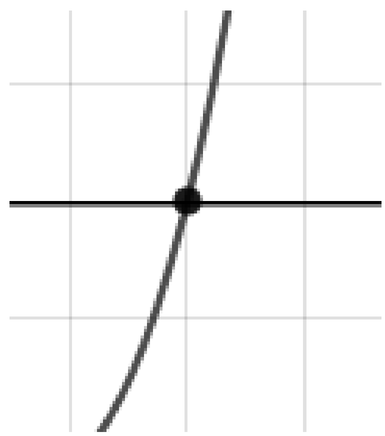
$$f(x) = 2(x+5)^4(x-5)^2(x+9)^{11}(x-9)^8$$

The solution is the graph below, which is option C.

A. 

C. 

B. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

---

27. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$5 + 3i \text{ and } -2$$

The solution is $x^3 - 8x^2 + 14x + 68$, which is option D.

A. $b \in [-3, 4], c \in [-1, 3]$, and $d \in [-8, -3]$

$x^3 + x^2 - x - 6$, which corresponds to multiplying out $(x-3)(x+2)$.

B. $b \in [5, 14], c \in [7, 19]$, and $d \in [-75, -65]$

$x^3 + 8x^2 + 14x - 68$, which corresponds to multiplying out $(x-(5+3i))(x-(5-3i))(x-2)$.

C. $b \in [-3, 4], c \in [-7, -2]$, and $d \in [-10, -8]$

$x^3 + x^2 - 3x - 10$, which corresponds to multiplying out $(x-5)(x+2)$.

D. $b \in [-12, -7], c \in [7, 19]$, and $d \in [67, 75]$

* $x^3 - 8x^2 + 14x + 68$, which is the correct option.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a+bi$ is $a-bi$. Since these zeros always come in pairs, we need to multiply out $(x-(5+3i))(x-(5-3i))(x-(-2))$.

---

28. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-2}{3}, \frac{7}{3}, \text{ and } 6$$

The solution is $9x^3 - 69x^2 + 76x + 84$, which is option A.

A. $a \in [3, 10], b \in [-71, -67], c \in [69, 84]$, and $d \in [82, 94]$

* $9x^3 - 69x^2 + 76x + 84$, which is the correct option.

B. $a \in [3, 10], b \in [-71, -67], c \in [69, 84]$, and $d \in [-86, -79]$

$9x^3 - 69x^2 + 76x - 84$, which corresponds to multiplying everything correctly except the constant term.

C. $a \in [3, 10], b \in [66, 74], c \in [69, 84]$, and $d \in [-86, -79]$

$9x^3 + 69x^2 + 76x - 84$, which corresponds to multiplying out $(3x-2)(3x+7)(x+6)$.

D. $a \in [3, 10], b \in [-43, -34], c \in [-106, -100]$, and $d \in [82, 94]$

$9x^3 - 39x^2 - 104x + 84$, which corresponds to multiplying out $(3x-2)(3x+7)(x-6)$.

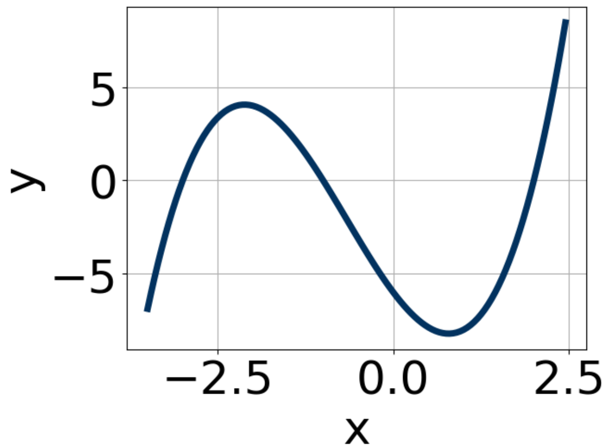
E. $a \in [3, 10], b \in [-81, -79], c \in [175, 180]$, and $d \in [-86, -79]$

$9x^3 - 81x^2 + 176x - 84$, which corresponds to multiplying out $(3x-2)(3x-7)(x-6)$.

General Comment: To construct the lowest-degree polynomial, you want to multiply out $(3x+2)(3x-7)(x-6)$

---

29. Which of the following equations *could* be of the graph presented below?



The solution is $20(x-2)^7(x+3)^5(x+1)^9$, which is option B.

A. $12(x-2)^6(x+3)^5(x+1)^7$

   The factor 2 should have been an odd power.

B. $20(x-2)^7(x+3)^5(x+1)^9$

   * This is the correct option.

C. $-17(x-2)^4(x+3)^7(x+1)^5$

   The factor $(x-2)$ should have an odd power and the leading coefficient should be the opposite sign.

D. $-14(x-2)^7(x+3)^{11}(x+1)^7$

   This corresponds to the leading coefficient being the opposite value than it should be.

E. $9(x-2)^4(x+3)^6(x+1)^9$

   The factors 2 and -3 have have been odd power.

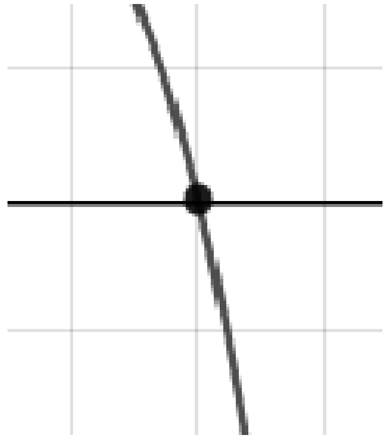
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

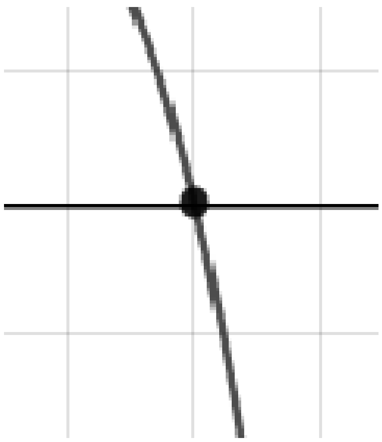
---

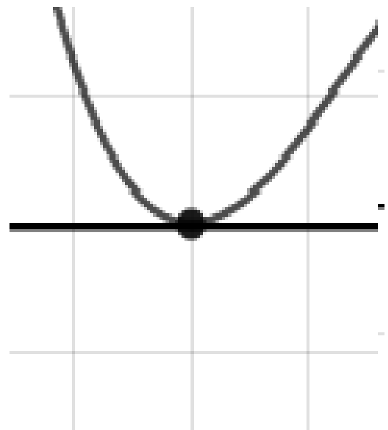
30. Describe the zero behavior of the zero $x = 4$ of the polynomial below.

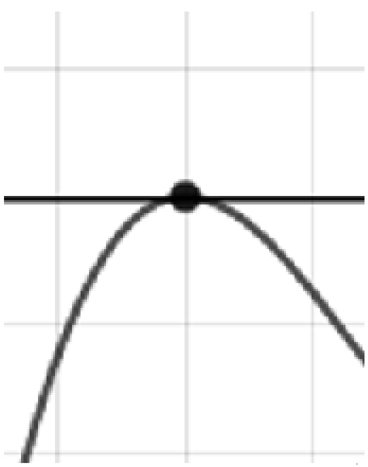
$$f(x) = 5(x-4)^9(x+4)^{10}(x-7)^9(x+7)^{10}$$

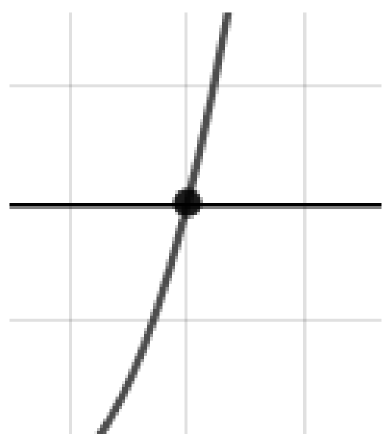
The solution is the graph below, which is option A.



A. 

C. 

B. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.